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DISCUSSION OF COOPERATIVE TOPOGRAPHIC MAPPING IN CALIFORNIA

TRACY L. ATHERTON.[1]—Mr. Ecklund's paper has covered the full fifty years of cooperative mapping in California. At the end of World War II the program was greatly accelerated when the Aerial Mapping Committee of the California State Reconstruction and Reemployment Commission recommended completion of adequate basic maps to cover the entire State of California. It planned completion within a period of ten years. Their estimate of the amount of funds required was made on the basis of early 1945 prices. Even at the time of Legislative adoption of the ten-year program in 1945 the dollar estimate of the committee was rapidly losing validity in the face of rising prices and wages. However, the appropriations have remained the same each year.

Production of topographic maps is tightly geared to wages which constitute about 70 per cent of the cost of the topographic mapping program. Last year on the announcement of an increase in the compensation of Federal employees, a conference was held to decide which and how many quadrangles must be dropped from the cooperative program.

Increases in population produce a surprisingly large number of changes in contours, drainage and new roads which must be reflected on a topographic map. In one rapidly growing section of the state where map revision was recently under way, changes were occurring at approximately the same rate as the field crew could discover and record the changes. After numerous delays in the scheduled return of the sheets, the revision project had to be given an arbitrary deadline. Land levelling, tract building, drainage ditch construction, reclamation, port works, etc., are so extensive in some sections of the state that certain maps which were expected to be adequate for years are rapidly becoming obsolete, and many maps which are scheduled for revision have required remapping instead.

Considerable time was required to put the program into its stride as will be seen in an inspection of the tabulation included in Mr. Ecklund's paper. This comes about because seasons materially affect the time required to produce a new topographic map. The photography of mountain tops must be accomplished late in the Summer when snow is melted and pictures cannot be controlled until the next Summer season. The elapsed time between the aerial photography and the publication of a new map is very seldom less than three years. Even the least difficult "revision" sheet will require a year unless specially scheduled. Accordingly it is found as of January 1, 1953, that there are 222 "cooperative" maps in various stages of preparation.

It will be seen that it is preferable to start a large mapping program

1. Map and Survey Information Section, California Div. of Water Resources, Sacramento, California.

gradually. If the present program were reduced immediately to the scale at which it was operative in 1945 it would take an extremely long time to finish up the quadrangles now in progress.

One statement in Mr. Ecklund's paper which might escape the reader's attention is that in 1951 only $1,250,000 was spent by the municipal and state governments for cooperative mapping in the United States. In view of the fact that the Federal Government will match such contributions 100 per cent, many more public agencies should take advantage of this opportunity to acquire this excellent mapping service at such bargin prices.

DISCUSSION OF SURVEYS AND MAPS—VITAL TO THE SOLUTION OF PROBLEMS OF MASS TRANSPORTATION

BENJAMIN EVERETT BEAVIN, SR.,* M. ASCE.—Perhaps the most valuable result of the paper was the fluent and able discussion elicited from Professor Milton O. Schmidt.[1]

A hopeful development in the field of surveying and mapping is the recent action of the U. S. Civil Service Commission in proposing a "Surveying and Mapping" Series for the classification of personnel. This action has been brought about largely as a result of widespread disapproval, by the profession, of the action taken by the Commission about two years ago. At that time, surveying and mapping activities were removed from an engineering classification and placed in a "Cartography" series. The newly proposed classification gives promise of restoring surveying and mapping to its rightful importance and recognizes the essential engineering character of the work.

As an example of the long time value of careful surveys, the author would like to call attention to a triangulation station, installed by the Coast and Geodetic Survey in 1845, and still serving as control for mapping and expansion of the U. S. Naval Academy.[2] This station added to the strength of the control used for surveys of the Chesapeake Bay Bridge and approach highways.

The forthcoming revision[3] of the Society's Manual No. 15, "Definitions of Surveying and Mapping Terms", should be very helpful in enabling surveyors and the users of the results of surveys to work together with clearer understanding.

A significant commentary on the constantly increasing importance of surveying and mapping is to state that in 1938, when Manual 15 was issued, less than 200 terms were considered to require defining; the revised manual will contain about 2500 definitions.

It seems to the author that the entire engineering profession, from the schools to the design and construction organizations, is awakening to the increased importance and value of surveying and mapping. It is to be hoped that an increased flow of well prepared young people, armed with the knowledge that surveying and mapping will offer them broad avenues for advancement, soon will make its weight felt in helping to solve the challenging problems of mass transportation.

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1. Prof. of Civ. Engr., Univ. of Illinois, Urbana, Ill.
2. See Article "Old Landmark Recovered at U.S. Naval Academy," Proceedings U.S. Naval Institute, Feb. 1947.
3. "Definitions of Surveying, Mapping, and Related Terms," Manual of Engineering Practice No. 34, ASCE, 1954.

DISCUSSION OF SURVEYS AND MAPS FOR PIPELINES

NORMAN O. GEUDER[1], J. M., ASCE.—Any transportation system, be it railroad, highway, or pipeline, can use the method described by the author to great advantage in the initial stages. Aerial photos, when properly interpreted, give a wealth of information which would take a great deal of time and money to acquire on the ground. Even in heavily forested areas such as are found in the Amapari River basin in the Federal Territory of Amapa in Brazil, such features as small streams and the divides between them can be ascertained from a properly interpreted set of aerial photos.

However, the accelerated survey schedules mentioned on page 3 can cause more expense than if a slightly alower schedule is used. 630 miles of survey work in six months is very good progress, but no choice of routes can be weighed with a progress such as this. It is possible that some savings have been overlooked. The operation with which the writer is associated had one such experience which, with one month's delay to the location party (about eight per cent of the total time required for the entire survey and at a cost of about $5,000), was able to save the owners some $150,000 in construction costs as well as a substantial savings in maintainance costs over the operational years. The accepted route lay for a distance of six kilometers along the edge of the Amapari River on side hills with slopes as steep as seventy per cent. By a straight line projection made in the office and based on the premise that a straight line is the shortest distance between two points as iterated by the author, it was possible to shorten the line, eliminate five kilometers of riverside reverse curving with some side hill cuts as deep as twenty meters, and reduce the dirt quantities by some 20,000 cubic meters. With the accelerated surveying procedures described by the author, this savings could not have been made. Thus the savings in time would have been offset to a disadvantage by additional initial cost and continued higher operational costs.

The author intimates on page 7 that the states which have well-defined standards of precision, monumentation, and mapping cause unnecessary survey expense. From the writer's experience with undefined easements and the litigation over mistaken property lines, a properly monumented line, easily discernable on the ground, will save more money for the owners over the years than the initial cost. These state laws, for the most part, were enacted at the suggestion of the men most experienced in the science of land surveying. An engineer who spends his early formative years in a survey crew for various type industries does not acquire the real essence of land surveying as related to property ownership. The land surveyor, who earns his livelihood at this

1. Engenheiro de Escritório de Estrada de Ferro, Divisao de Construçao, Indústria e Comércio de Minérios, S/A, Caixa Postal, 396, Belém, Pará, Brasil.

profession, has studied much more than the normal engineering school curriculum offers; he has sometimes learned the need for precision the hard way. The individual working in an industrial survey crew is in the area for the one survey only and unprecise work will not cause him discomfort at a later date. The writer sympathizes very strongly with the states which have these standards and would urge that they be adhered to even in those regions which do not require them as being in good professional practice.

In the author's conclusion, good reasons for speed in surveys of this nature are advanced. While speedy surveys will cause savings in interest costs and speed the day when the profits roll in, they can, unless carefully controlled, overextend themselves to the detriment of the project by the bypassing of long term savings in exchange for small initial savings. A careful survey with sufficient time to complete each section well in advance of any construction activity, although costing more initially, will save money, headaches, and worries over the operational years sufficient to usually offset advantageously the initial extra expense.

DISCUSSION OF AERIAL SURVEYS FOR RESERVOIR PLANNING

LEWIS A. DICKERSON,[1] M. ASCE.—Mr. Guscio's paper covers well a field of engineering to which aerial surveying has been applied with marked advantage. Particularly well presented is the need for advance planning to insure that the survey procedures produce suitable data for all the anticipated requirements with a minimum of cost and effort.

In the last sentence of the second paragraph of his Introduction, Mr. Guscio makes a statement that this writer feels needs much emphasis. The situation pointed out is common to surveys for many engineering projects and is a situation that aerial photogrammetric surveys have done much to correct. Even though aerial methods may not always accomplish the work for less cost, they almost always produce a better survey as a result of larger area coverage, more complete information obtained and a uniform accuracy throughout. These have undoubtedly resulted in better and more economical engineering designs with attendant savings in construction costs which really should be credited to the aerial surveys.

In the first paragraph of his Introduction, Mr. Guscio refers to the data from various topographic surveys assembled for preliminary planning purposes. He has been fortunate in having to secure only a "limited amount of new field survey data". That would not likely be the case in that approximately 50% of this country that has absolutely no topographic data in existence. In such areas, the aerial photogrammetric survey method becomes of even more importance for it is adaptable to almost any accuracy desired for preliminary planning purposes and at low costs. Present day equipment and methods are capable of preparing preliminary maps in such areas without any additional field work. Such maps surpass in accuracy those older topographic maps covering some parts of this country and even closely approach some of the modern topographic maps. Progress is emphasized by the fact that such preliminary mapping costs only in the order of $10.00 or $15.00 per square mile.

In the third paragraph of the Introduction it is stated that the objective was to use only "one series of aerial survey flights". This is a desirable objective but is not necessarily the one that should be adhered to in all cases. In the case of only topographic mapping of the entire reservoir area it should be adhered to for it will be the highest accuracy requirement decided as necessary for the entire area to be mapped that governs the manner of the flying. Should there be a requirement for mocaics in addition to the topographic maps then economy may some times be realized by flying separate coverage for that purpose. In addition, some smaller parts of the area may require higher accuracies in topographic mapping and should be flown again at a lower altitude, for

1. Lockwood, Kessler and Bartlett, Inc., Cons. and Development, Great Neck, N. Y.

example, likely relocation areas or dam sites.

It is in the matter of higher accuracy surveys for areas such as dam sites that Mr. Guscio can look forward to increased applications of aerial survey methods in his reservoir projects. Such methods are being applied today successfully at scales as large as 1:240 and with contour intervals as small as one foot. The writer feels that the methods are applicable to the mapping of dam sites and to secure the design data required for relocations. The methods can even be used to determine the cross section along the established silt ranges to an accuracy consistent with that later achieved in sounding the depths to the silt layer. To achieve economy in these surveys requires thorough advance planning so that aerial photography and field survey requirements may be properly scheduled and accomplished along with similar operations for the larger reservoir area.

Mr. Guscio makes several references to the "controlled mosaic" that was prepared and used for many purposes. This writer believes it desirable to point out that such a mosaic made available no information or data not already supplied by the topographic maps and the individual aerial photographs from which the maps were prepared. It did make the photographic information available in a more convenient form for the varied uses to which it was put. This probably justified the cost involved in its preparation. Although the paper does not indicate how well the mosaic was controlled, this writer believes that a highly accurate mosaic would not be justified on projects of the nature described.

Mr. Guscio indicates that the aerial photographs were of much value in determining the land ownership lines after the topographic mapping was complete. It is pertinent to note that, when appropriate, ownership lines can be also located in the process of the mapping. Property corners and/or lines identified on the aerial photographs as a result of field work and deed and plat study are plotted into correct map position during the photogrammetric operation. The extra effort required during this operation is insignificant.

Corrections for Transactions.—On page 407-5, in the 3rd line of the last paragraph of "Reservoir Development and Management," the wording "leasing and facilities construction" should be corrected to read "leasing sites, facilities construction."

DISCUSSION OF THE MAPPING OF BUFORD RESERVOIR

GEO. D. WHITMORE,* M., ASCE.—Mr. Riley's description of the mapping of Buford Reservoir presents an extremely optimistic picture of the possibilities of precise mapping by photogrammetric methods. This observer, a long-time advocate of photogrammetric procedures, can not help but conclude that Mr. Riley, in his optimism, has not stressed some salient facts that are of key importance in evaluating the results obtained. There is danger in these omissions in that an unwary reader might easily be misled into employing procedures that are not at all practicable and that Mr. Riley does not indeed mean to champion.

Taking Mr. Riley's paper at its face value, one gathers that the mapping was done entirely with the Kelsh plotter, using the usual 6-inch vertical photography taken at an altitude of 14,000 feet above mean ground. The contour intervals were 10 feet and 5 feet; also two critical contours were run out, presumably to an accuracy considerably better than one-half interval. The implication of the article is that all of these data were developed by standard Kelsh-plotter compilation procedures. This would mean that the Kelsh plotter was used at a C-factor $\left(\frac{\text{Flight Altitude}}{\text{Contour Interval}}\right)$ of 1400 for the 10-foot contours, and 2800 for the 5-foot contours.

Extensive experience by governmental and private photogrammetric organizations alike indicates that although there is a fair chance of getting by with a 1400 C-factor for the Kelsh plotter under favorable conditions, planning a job with a 1400 C-factor would certainly not be on the conservative side. But the use of a C-factor of 2800 would, under average conditions, almost certainly result in failure to meet standard accuracy requirements. Nothing is said about the use of a "secret weapon," such as a new kind of photography, or about the incurring of high costs in a secondary direction, such as peppering the area with field-survey control. If a "secret weapon" had indeed been used, Mr. Riley would be in line for congratulations on his technical coup, but the omission of that fact in his paper would be a disservice to others who might undertake to obtain similar results by normal procedures.

This concern has been expressed to Mr. Riley and he has very kindly supplied the information which answers the questions raised. The map, it seems, was basically a 10-foot map, with a few supplementary 5-foot contours. By establishing a very large number of ground-survey elevations on selected picture points in the 5-foot areas, it was possible, with considerable field work, to develop the 5-foot contours with standard accuracy. Presumably the two critical contours were also developed by means of a large amount of field work. This procedure is in line with good mapping practice; that is, when only a small portion of the area

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mapped requires a smaller contour interval it is often most economical to invest additional field work in these limited areas. The successful use of the 1400 C-factor for 10-foot work can also be attributed to the large amount of vertical control established in the field (426 picture points for 60 models, as against a normal requirement of about 120 points).

It is regrettable that Mr. Riley did not make the total procedure plain from the start so as to avoid giving a misleading impression about the capabilities of the Kelsh plotter. Engineers need to be alert to the decided advantages of photogrammetric procedures for many kinds of mapping enterprises. At the same time, they should not come to expect miracles of photogrammetry. The failure of such a miracle to materialize can easily blind the engineer to the real, but still-short-of-miraculous, benefits of this technique.